Selection and Design of Wedge Wire Screens and a Fixed-Panel Aquatic Filter Barrier System to Reduce Impingement and Entrainment at a Cooling Water Intake Structure on the Hudson River

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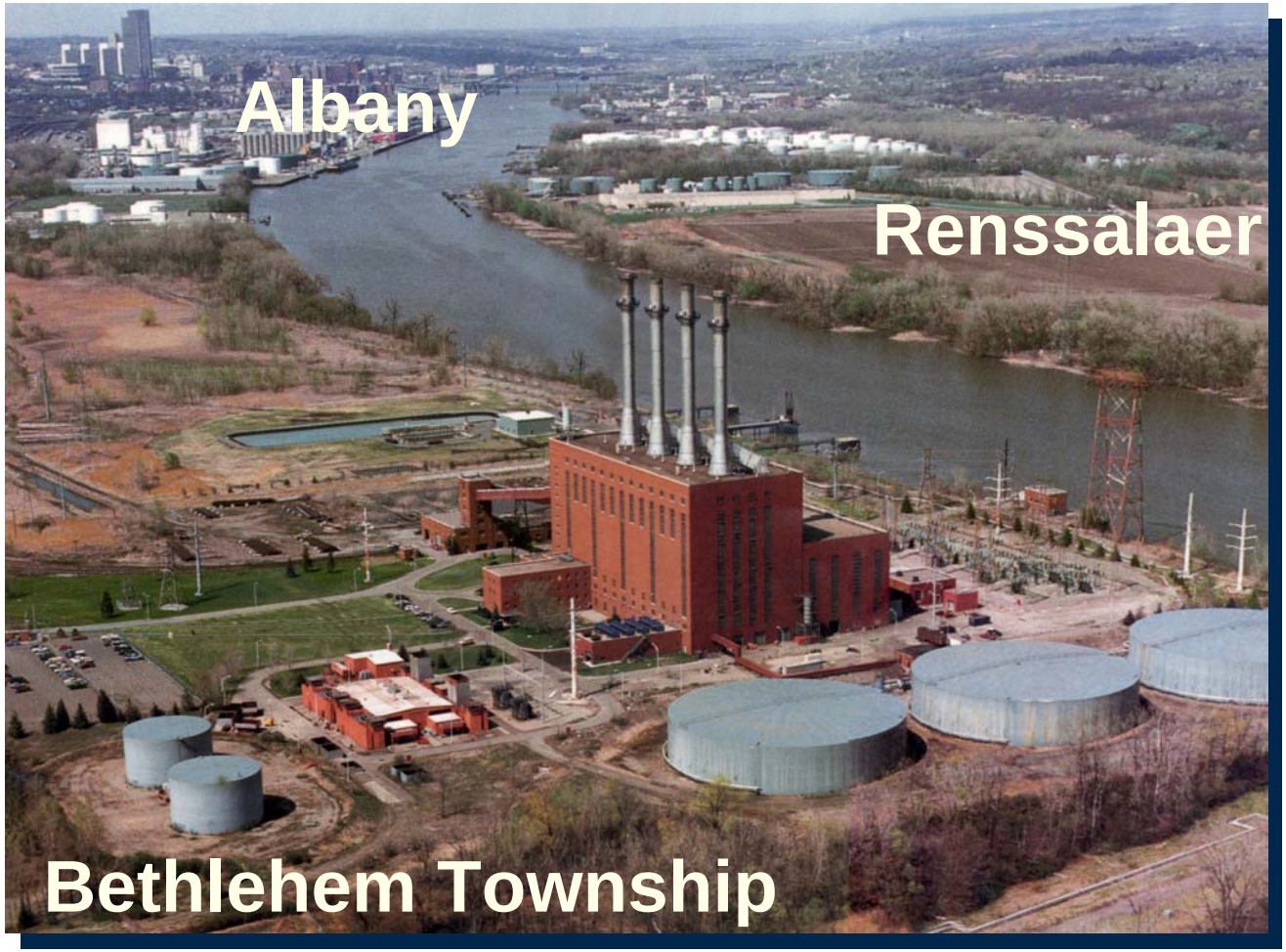
PSEG
Power New York

Outline

- Project Background
- Alternative Cooling Systems Study
  - Alternatives evaluated
  - Overview of findings
  - Public Participation Process
- Final Design
  - Configuration
  - Monitoring

Albany Steam Station



- PSEG Power New York LLC purchased from Niagara Mohawk in May 2000
- 400 Megawatts
- Natural gas and residual oil fired
- Constructed between 1952 and 1954

Bethlehem Energy Center

Efficient state-of-the-art technology

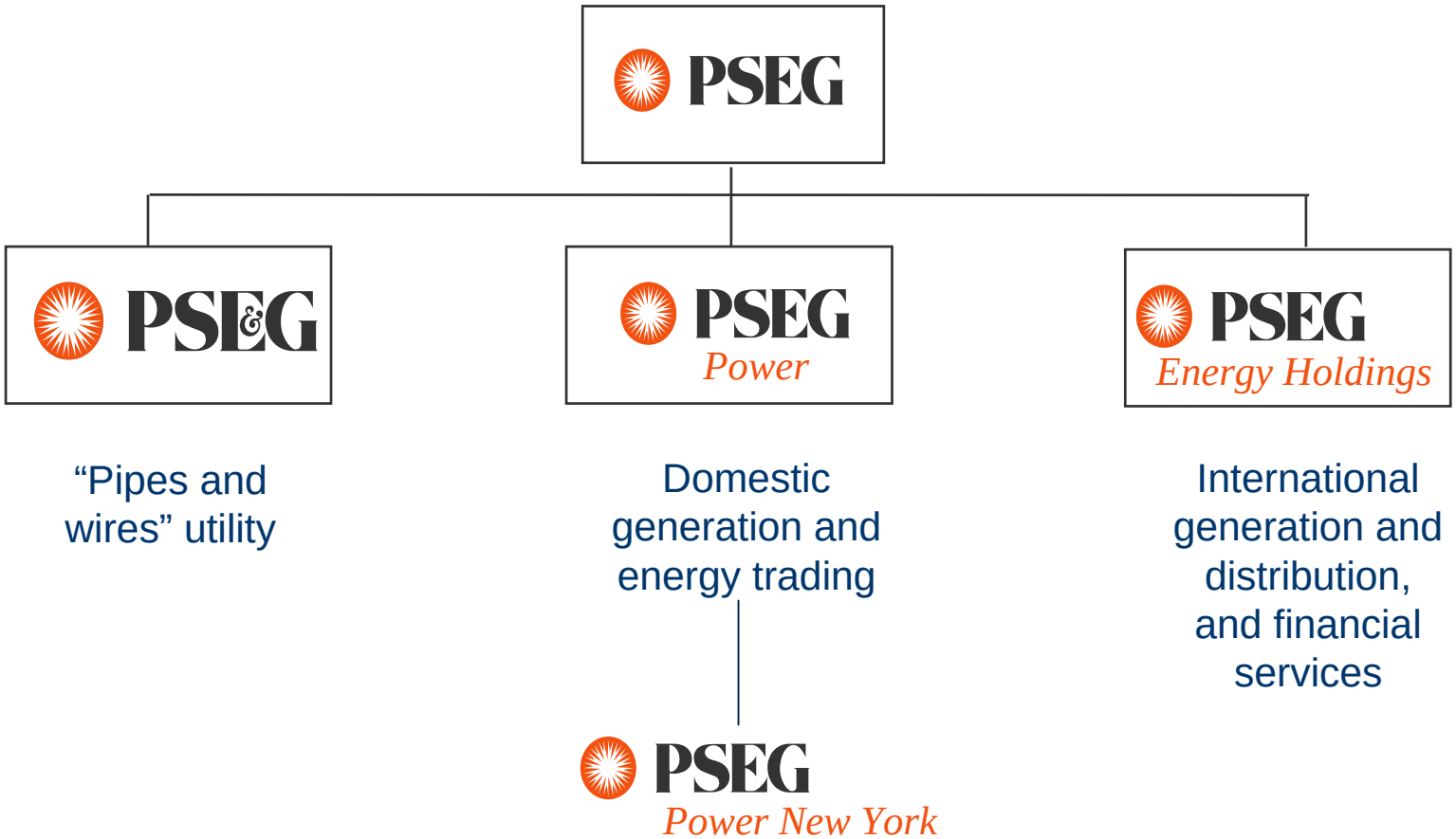
- 750 Megawatts
- 3 GE 7FA combustion turbines
- New, efficient steam turbine
- Natural gas as primary fuel

Significant environmental improvements

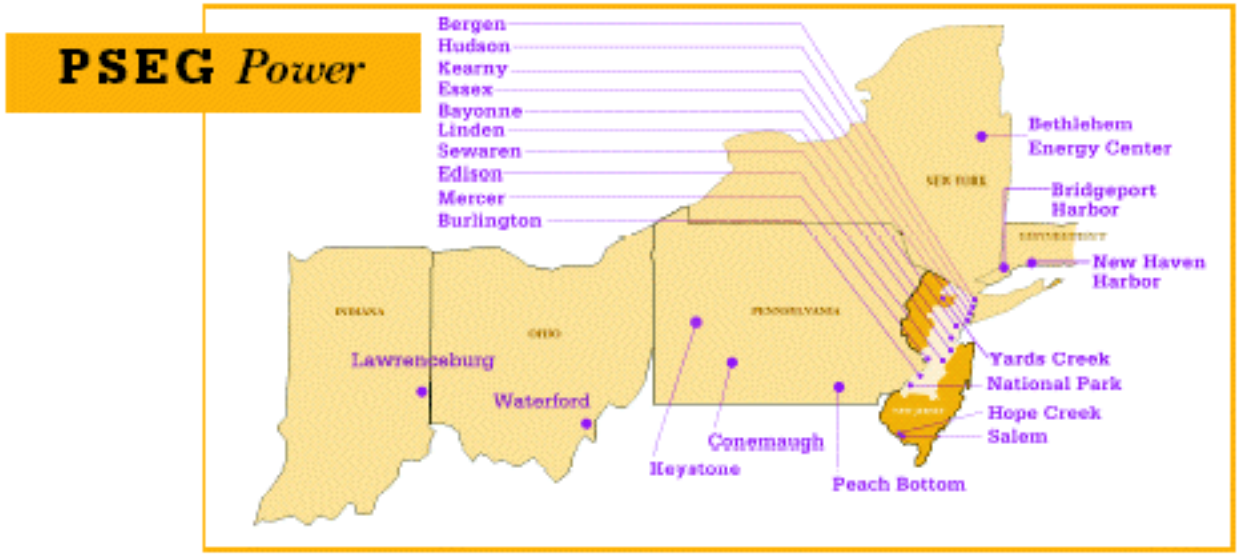
- SO2 and NOx emission rates reduced 98% and 97%.
- Water usage reduced 98-99%.
- Redevelopment of existing industrial site

Planned start-up in 2005

The PSEG Family of Companies



PSEG Power



PSEG Power currently has more than 19,000 megawatts of generating capacity in operation, construction, or advanced development in six states

Alternative Cooling Systems Study

- Selection of Best Technology Available is a site-specific process in New York
- An analysis of cooling system alternatives was prepared by PSEG Power New York Inc (PSEGNY) to provide site-specific information for the evaluation of PSEGNY's application for the Bethlehem Energy Center

Cooling System Alternatives

- Alternatives evaluated:
  - Once-through cooling
  - Wet tower with 2-mm wedgewire screens
  - Wet/dry (plume abatement) tower with 2-mm wedgewire screens
  - Dry tower (air cooled condenser)
- Proposed alternative:
  - 2-mm wedgewire screens
  - Wet cooling tower
- Final design:
  - 2-mm wedgewire screens
  - Wet/dry (plume abatement) cooling tower
  - Seasonally-deployed aquatic filter barrier system

The Evaluation

- Parameters Analyzed
  - Plant performance
  - Air emissions
  - Noise
  - Aesthetics
  - Aquatic impacts
  - Incremental costs and benefits

Plant Performance

- The once-through cooling system alternative provides the best overall thermodynamic efficiency
- At 78ºF, the efficiency of the dry tower alternative is projected to be 1.16% lower than that of the wet tower design
- At 94ºF about 2.40% more fuel is needed to generate the same amount of electricity

Air Emissions

- Modeled stack emissions associated with each of the main cooling system options:
  - Sulfur dioxide (SO_2)
  - Nitrogen oxides (NO_x)
  - Carbon monoxide (CO)
  - Particulate matter 10 microns or less in size (PM_{10})
  - Volatile organic compounds (VOC)
  - Ammonia (NH_3)
  - Carbon dioxide (CO_2)
- Wet and wet/dry tower alternatives were comparable
- Dry tower alternative produced about 1% more emissions annually

Air Emissions

- Wet and wet/dry cooling tower emissions were modeled to estimate the annual ambient air quality concentrations
- Emissions of total solids (particulates) and other compounds from the wet and wet/dry cooling tower were estimated to be very small compared to health-based benchmark concentrations

Noise

- Computer sound modeling was used to estimate ambient sound impacts at six sensitive receptor locations
- Sound goals could be achieved at each of the six sensitive receptor locations for the once-through, wet, and wet/dry cooling options
- Sound produced by the dry cooling option would marginally exceed the project goals

Aesthetics

- Each cooling system alternative was evaluated with regard to the aesthetic impact on the visual setting
- An artist’s rendering was produced for each alternative

Existing Station

- **Alternatives were compared to the aesthetic profile of the existing station and existing viewshed**

Once-Through Cooling Alternative

- **No visual impacts associated with cooling tower structure or vapor plumes**

Wet Cooling Tower Alternative

- **Visual impact of structures is similar to that of existing station**
- **Visible plume consistent with character of existing viewshed**

Wet/Dry Tower Alternative

- **Visual impact of structures is similar to that of existing station and wet tower alternative**
- **Visible plume less frequent than from wet tower**
- **Consistent with character of existing viewshed**

Dry Tower Alternative

- **Nearfield visual impacts are greater because of the size and industrial character of the structure (taller than HRSG building)**
- **No vapor plumes**
- **Generally consistent with character of existing viewshed**

Dry Tower Alternative

- **Dominant structure when viewed from road**

Aquatic Impacts

- Bethlehem Energy Center will use substantially less water than the existing station (98-99% less water withdrawn from the Hudson River)
- The approach velocity at the intake for the wet tower and wet/dry tower alternatives would be 90-95% less than at the existing station

Primary Aquatic Populations

- Impingement
  - Total of 58 fish species identified from the Albany Station traveling screens
  - Blueback herring and white perch represent 45 and 19% of the estimated annual impingement
  - Other dominant species impinged were alewife, American shad, and spottail shiner
- Entrainment
  - Total of 24 fish taxa identified from ichthyoplankton sampling surveys near the Albany Station
  - River herring (43%), unidentified herring(17%), tessellated darters (13%), white perch (11%), and American shad (7%) dominated the 2001 entrainment monitoring program collections
  - 1983 entrainment collections dominated by river herring and white perch

Impingement and Entrainment Reductions

- Wedgewire screens will virtually eliminate impingement
- Entrainment will be reduced by over 98% compared to existing station
- With the addition of an aquatic filter barrier system, entrainment will be reduced by over 99% compared to the existing station

Cost/Benefit Analysis

- Included to provide a useful framework for organizing and evaluating the quantifiable, site-specific attributes of the alternatives
- The quantifiable incremental costs and benefits for each cooling system alternative were estimated and compared to the proposed alternative (wet tower with wedgewire screens)

Public Participation

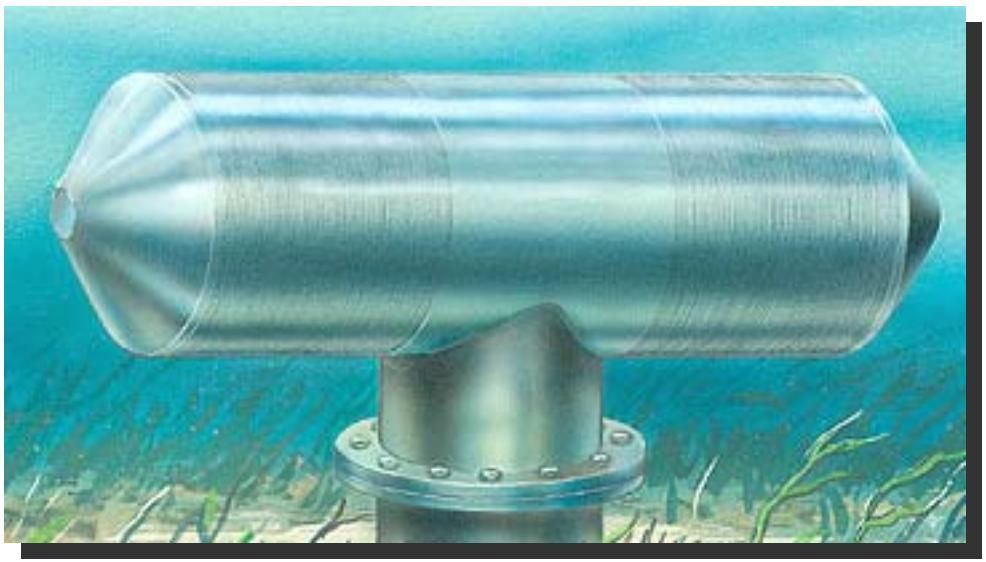
- Public participation is a critical component of power plant siting decisions in New York State
- An applicant must carry out a meaningful public involvement program
  - Public outreach through direct mailings, media coverage, newsletters, websites, etc
  - An applicant is expected to hold public meetings, offer presentations to individual groups and organizations, and establish a community presence
- PSEGNY actively engaged agencies, municipalities, commissions, non-profits and individual interested parties in the evaluation and approval process

Final Design

Based on examination of site-specific information, and taking into account the interests of the agencies and other interested parties, NYSDEC and the New York State Board on Electric Generation Siting and the Environment required the following components in the final design for BEC:

- 2-mm wedgewire screens
- Wet/dry, plume abatement cooling tower
- Seasonally-deployed aquatic filter barrier system

Wedgewire Screens



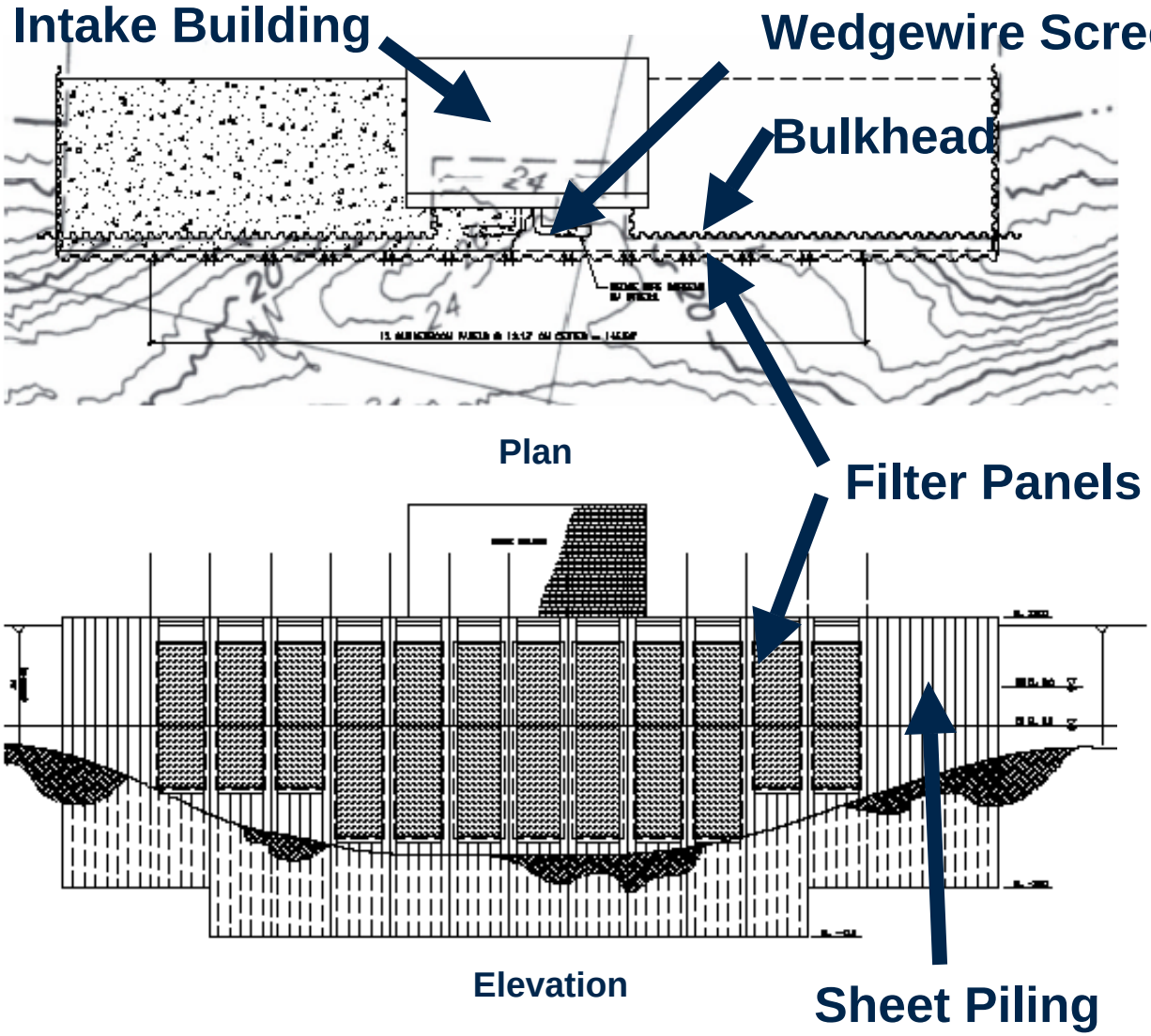
Johnson Screens ™

- 2-mm slots
- Cantilevered off face of existing intake structure
- Virtually eliminates impingement
- Passive cleaning and pressurized air backwash

Wet/dry Cooling Tower

- Artist's rendering of estimated average visible plume
- Conservative design will reduce the occurrence of visible plumes by about 75% compared to a wet tower

Aquatic Filter Barrier System



Intake Building

Aquatic Filter Barrier System

- Required from April 1 through July 31
- 0.4mm pore size
- <5 gpm/ft^2
- Currently working with Gunderboom Inc. to install Marine Life Exclusion System™ for 2005 start-up

Proposed Monitoring Program

- Coincide with Aquatic Filter Barrier deployment
- Entrainment monitoring in front of and behind the Aquatic Filter Barrier
- Sampling over 24-hr periods at weekly intervals from April through July
- April through July encompasses peak period for the presence of ichthyoplankton in this reach of the Hudson River

Monitoring Reports

- Annual entrainment monitoring reports
- Information will be collected on species composition, relative abundance, and temporal distribution of fish eggs, larvae, and juveniles

Monitoring Reports

- The ratio of the weekly ichthyoplankton density in front of the Aquatic Filter Barrier to the density behind will provide an index of the effectiveness of the system for minimizing entrainment
- Physical indicator measurements (water level differentials, visual screen inspection) will be correlated with the biological effectiveness measurements